REMARKS

Applicant would like to thank the Examiner for the careful consideration given the present application. The application has been carefully reviewed in light of the Office action, and amended as necessary to more clearly and particularly describe the subject matter which applicant regards as the invention.

The Examiner has rejected claim 1 under 35 U.S.C. 102(b) as being anticipated by "The Concept of a Walking Assistance Suit" to Kato. The Examiner's rejection is traversed for the following reasons.

The present invention relates to a method of estimating a joint moment of a bipedal walking body. The method including a first step for sequentially grasping the displacement amounts of a plurality of joints, including at least an ankle joint, a hip joint and a knee joint of each leg of a bipedal walking body, and a second step for sequentially grasping the positions and/or postures of corresponding rigid bodies of the bipedal walking body that are associated with rigid elements of a rigid link model using at least the rigid link model. The rigid link model is established beforehand to express the bipedal walking body in the form of a link assembly composed of a plurality of the rigid elements and a plurality of joint elements and the grasped displacement amounts of the joints. The method further includes a third step for grasping the acceleration of a preset reference point of the bipedal walking body by using at least an output of an acceleration sensor attached to a predetermined region of the bipedal walking body, and a fourth step for sequentially grasping a floor reaction force acting on each leg and the position of an acting point of the floor reaction force. The grasped positions and/or the postures of the corresponding rigid

bodies of the bipedal walking body, the acceleration of the reference point, the floor reaction force, and the position of the acting point of the floor reaction force are used to estimate a joint moment acting on at least one joint of each leg. At least the displacement amounts of the hip joint, the knee joint, and the ankle joint of each leg that are grasped in the first step include the amount of rotation about an axis substantially perpendicular to a leg plane as a plane passing through these three joints. The displacement amount of the hip joint is a three-dimensional amount, and the positions and/or postures of the corresponding rigid bodies grasped in the second step include at least the positions and/or the postures of the corresponding rigid bodies of the leg on the leg plane, the acceleration of the reference point grasped in the third step and the floor reaction force and the position of the acting point of the floor reaction force grasped in the fourth step are three-dimensional amounts. A component of a joint moment acting on at least one joint of the leg about the axis that is substantially perpendicular to the leg plane is estimated on the basis of an inverse dynamic model representing the relationship between the motions of the corresponding rigid bodies of the leg and the translational forces and the moments acting on the corresponding rigid bodies on the leg plane by using the two-dimensional amounts obtained by projecting at least the acceleration of the reference point, the floor reaction force, and the position of the acting point of the floor reaction force onto a leg plane related to the leg on the basis of a displacement amount of the hip joint of the leg, and the positions and/or the postures of the corresponding rigid bodies of the leg on the leg plane.

Kato involves the research of walking assistance suits. In particular, Kato concludes that to prevent muscle decay, humans must use about 30% or more of

their maximum muscle strength. Additionally, the floor reaction force can approximately be estimated from each joint angle measurement value and the displacement estimation value of the center of gravity without using any large-scale measuring equipment.

Claim 1 of the present application recites "a first step for sequentially grasping the displacement amounts of a plurality of joints, including at least an ankle joint, a hip joint and a knee joint of each leg of a bipedal walking body." Review of Kato does not reveal this step. For convenience, Expressions 9 and 10 of Kato (Untranslated Portion; Pg. 2, Sect. 4) are reproduced below.

$$\frac{Z_G - Z_R}{X_G - X_R} = \frac{F_{RZ}}{F_{RX}} \qquad (9) \qquad\qquad \frac{Z_G - Z_L}{X_L - X_G} = -\frac{F_{LZ}}{F_{LX}} \qquad (10)$$

Review of Expressions 9-10 and Pg. 11 of Kato reveals that Kato only discloses measuring the left and right ankle joint coordinates (X_L, Z_L, X_R, Z_R). However, there is no disclosure in Kato of measuring a hip joint and a knee joint of each leg as required by claim 1 of the present application. Therefore, Kato cannot be cited for disclosing "a first step for sequentially grasping the displacement amounts of a plurality of joints, including at least an ankle joint, a hip joint and a knee joint of each leg of a bipedal walking body." Accordingly, removal of the rejection of claim 1 is hereby requested.

Claim 1 of the present application further recites "a fourth step for sequentially grasping a floor reaction force acting on each leg and the position of an acting point of the floor reaction force, the grasped positions and/or the postures of the corresponding rigid bodies of the bipedal walking body, the acceleration of the reference point, the floor reaction force, and the position of the acting point of the

floor reaction force being used to estimate a joint moment acting on at least one joint of each leg." Kato also fails to disclose this step. In Kato, the floor reaction force acting point position is fixed to the ankle joint position when estimating the floor reaction force. (Pg. 11, lines 23-25). As such, Kato cannot be cited for teaching the fourth step of the present application. Therefore for this further reason, the rejection of claim 1 should be removed.

Claim 1 also recites that "at least the displacement amounts of the hip joint, the knee joint, and the ankle joint of each leg that are grasped in the first step include the amount of rotation about an axis substantially perpendicular to a leg plane as a plane passing through these three joints." Review of Kato does not reveal this feature. In fact, Kato does not disclose the concept of the leg plane as a plane passing through the hip joint, the knee joint, and the ankle joint of each leg. Therefore, Kato cannot be cited for measuring the amount of rotation about an axis substantially perpendicular to a leg plane as the displacement amount of each joint (e.g. ankle joint). Accordingly, removal of the rejection of claim 1 is requested.

Claim 1 of the present application further recites that "the acceleration of the reference point grasped in the third step and the floor reaction force and the position of the acting point of the floor reaction force grasped in the fourth step are three-dimensional amounts." Kato does not disclose this feature. As is shown in Expressions 7-10 of Kato, the acceleration of the reference point (X_G, Z_G), the floor reaction force (F_{LX}, F_{LZ}, F_{RX}, F_{RZ}), and the position of the acting point of the floor reaction force (X_L, Z_L, X_R, Z_R) are two-dimensional amounts, not three-dimensional amounts as is recited in claim 1 of the present application. Therefore, the rejection of claim 1 should be removed.

The Examiner has rejected claims 2-7 under 35 U.S.C. 103(a) as being unpatentable over Kato in view of U.S. Pat. No. 6,289,265 to Takenaka et al. The Examiner's rejection is traversed for the following reason.

Takenaka involves a controller for a legged mobile robot. In particular, Takenaka relates "to a posture control system of a legged mobile robot, and more specifically a system for conducting a compliance control on the motion of the legs of a legged mobile robot, in particular a biped robot, and controls the floor reaction force acting on the robot appropriately" (Col. 1, lines 7-12).

Takenaka does not correct the deficiencies of Kato. More specifically, Takenaka concerns an entirely different concept and does not conduct any estimation as recited in claim 1 of the present application. Therefore, even if the references were combined, they would still be deficient. Thus, the Examiner has failed to provide a *prima facie* case of obviousness of claim 1, from which claims 2-7 depend. Therefore, the rejection of claims 2-7 must be withdrawn.

In light of the foregoing, it is respectfully submitted that the present application is in a condition for allowance and notice to that effect is hereby requested. If it is determined that the application is not in a condition for allowance, the Examiner is invited to initiate a telephone interview with the undersigned attorney to expedite prosecution of the present application.

If there are any additional fees resulting from this communication, please charge same to our Deposit Account No. 18-0160, our Order No. SAT-16451.

Respectfully submitted,

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